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UK CL (Edition K) H1B, H2H HBCD HBCE HBCF HBCG
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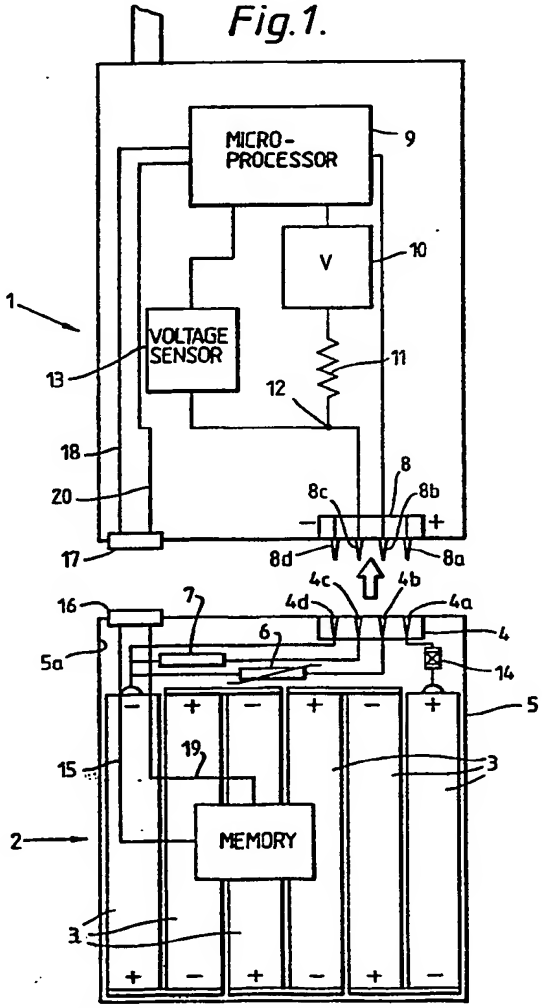
(54) Rechargeable battery incorporating memory for use in portable electronic apparatus

(57) A rechargeable battery (2) for portable electronic apparatus such as a cellular telephone (1) comprises a housing (5) enclosing one or more rechargeable cells (3) and a memory (6), e.g. an EEPROM, for storing information such as the voltage/current characteristics of the battery and/or the number of previous recharge cycles, such information being indicative of the condition of the cells. This information can then be used to select a charging programme best suited to the prevailing condition of the battery, and hence optimise the longevity and performance of the battery.

Fig.1.



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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Fig.1.

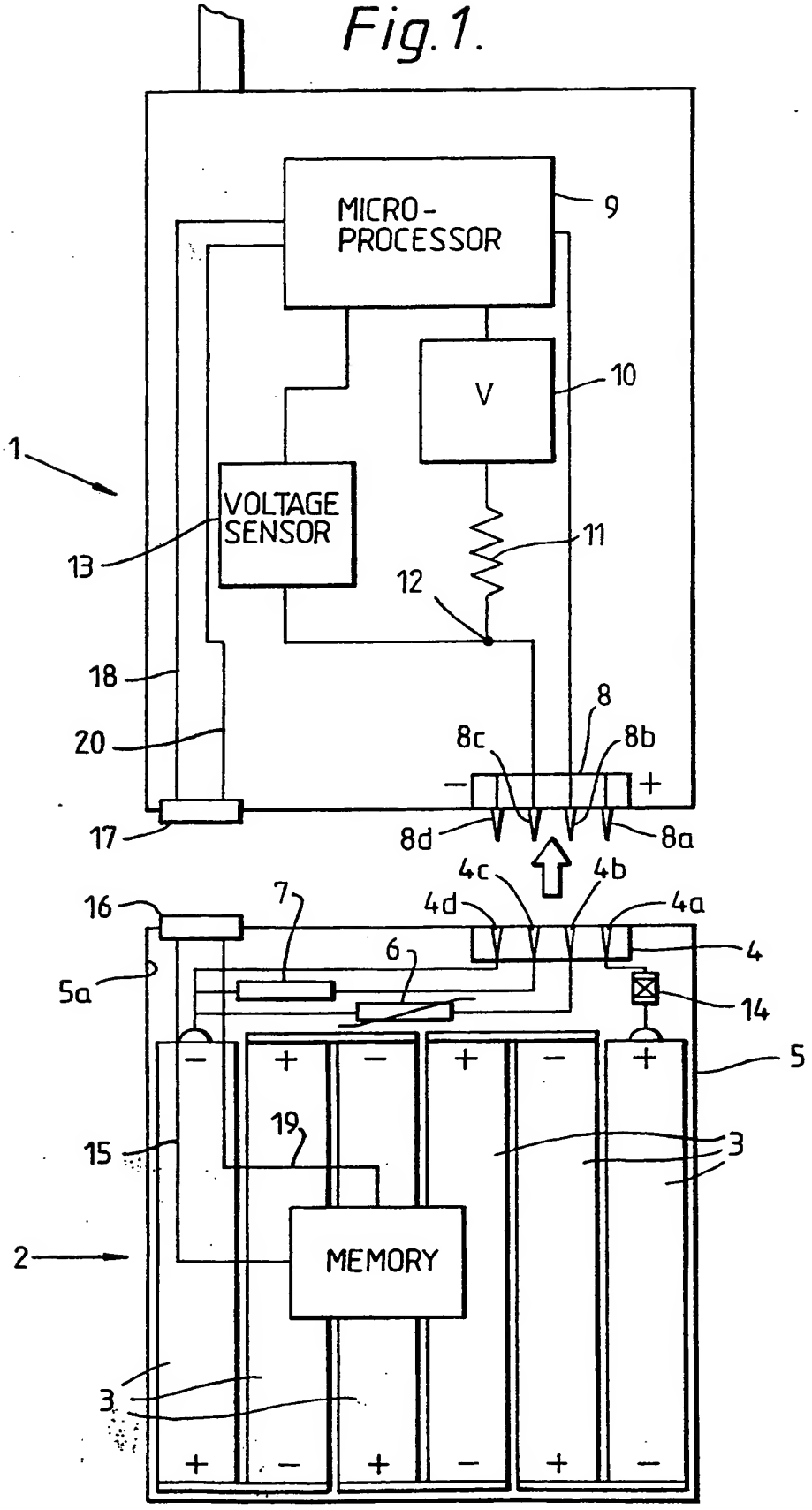
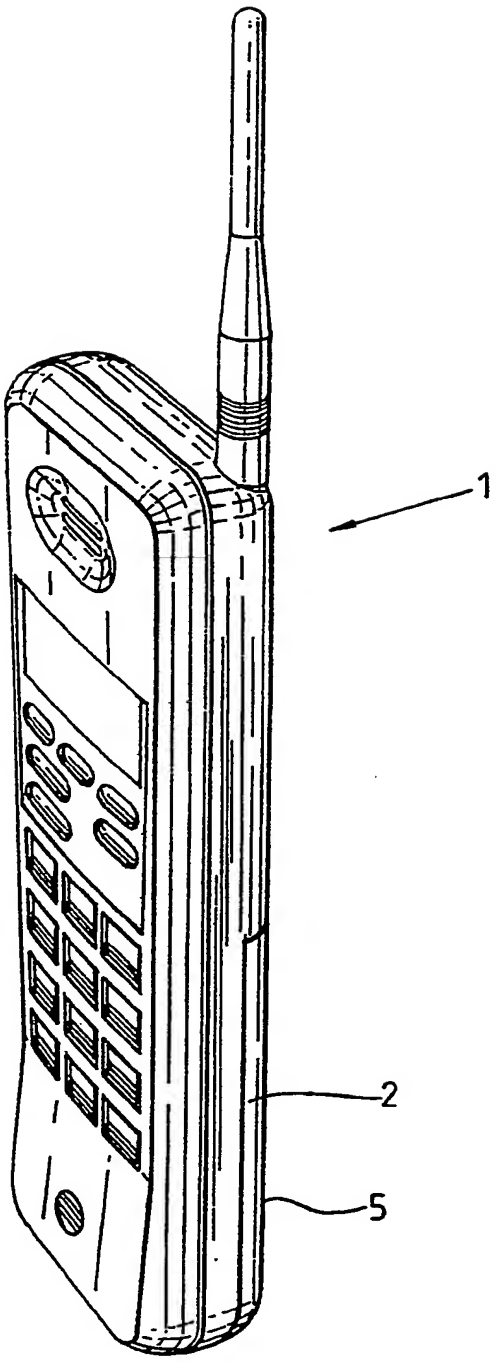


Fig. 2.



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RECHARGEABLE BATTERY

This invention relates to a battery comprising a housing enclosing one or more rechargeable cells for use in a portable electronic apparatus.

Nowadays, rechargeable batteries, e.g. comprising NiCd cells, are commonplace for powering a large variety of portable electronic apparatus.

By way of example, rechargeable batteries can be used in hand-held cellular radio telephones, so that the subscriber equipment is truly portable. However, particularly because of their transmission capability, portable cellular telephones consume a significant amount of power, necessitating relatively frequent changing and/or recharging of the batteries.

It is believed that the useful life of a rechargeable battery depends on how it is treated and in particular on the manner in which it is charged under different conditions. In other words, it is possible to optimise the useful operating life of a rechargeable battery by adopting an appropriate charging regime.

To this end it is known to monitor various parameters associated with the battery, e.g. the number of discharge cycles, and/or the voltage/current characteristics etc, from which it is possible to determine the condition of the rechargeable cells. Hence, at the time of recharging, the appropriate charging characteristics may be selected depending on the prevailing battery condition.

Conventionally, battery monitoring is effected and the results processed entirely within the portable apparatus or within a separate charging apparatus; in

both cases remotely from the battery itself. This has the disadvantage that historic information about a replacement battery is not available because all stored information is in general erased (or otherwise lost) whenever the battery is changed. This is not a problem if the replacement battery is unused. However, if the replacement battery has in fact been used previously, there is no means of knowing, for example, the number of recharging cycles which the battery has already undergone. On the contrary, the monitoring process will proceed on the basis that the battery is unused, i.e. has previously undergone zero charging cycles, and the recharging programme will be selected accordingly. Obviously, therefore, the optimal charging programme may not be selected and consequently the overall life and performance of the battery may be impaired. This will clearly be a major disadvantage if battery packs are frequently interchanged before they have exhausted their useful lives.

According to the present invention there is provided a battery comprising a housing enclosing one or more rechargeable cells and memory means for storing information relating to the condition of said cell(s).

A battery in accordance with the invention has the advantage that it keeps its own internal log or record of the parameter(s) which are monitored. Historic information is thus always available whenever the battery is changed so that the most appropriate charging programme can be selected taking into account the full history of the battery rather than proceeding on the assumption that a replacement battery is unused.

The memory means may suitably be capable of storing at least two different categories of information relating to the condition of the cell(s), for example the number

of charge and/or discharge cycles and the current/voltage characteristics during normal operation and/or during recharging.

Preferably means are provided enabling information to be transferred to and/or from the memory means from outside the housing. Hence the condition of the cells may be monitored and the results processed by a computer remote from the battery itself. The computer may be located in the electronic apparatus which is to be powered by the battery or in a separate recharging apparatus. The end results of the monitoring process may nevertheless be stored in the memory means within the battery. Alternatively, however, the computer may be located within the battery housing.

An embodiment of the invention will now be described by way of example, with reference to the accompanying drawings in which:-

Figure 1 is a schematic illustration of a radio telephone shown separated from an interchangeable rechargeable battery in accordance with the invention, and

Figure 2 is a perspective view of the radio telephone in Figure 1, with the battery connected to the telephone.

The apparatus shown in Figures 1 and 2 is a cellular portable telephone 1 comprising a rechargeable battery pack 2. The battery pack 2 may for example contain six identical series-connected NiCd cells 3 each having a nominal voltage of 1.2V. The battery pack, therefore, has a nominal voltage of 7.2V. The capacity of the cells is typically 600 mAh for a regular battery pack, whereas in the case of a high energy version the

capacity may be, for example, 850 mAh.

The individual cells are rectangular in cross-section and are arranged side-by-side in close packed configuration to yield a particularly compact battery pack 2. In an alternative arrangement the cells may be arranged in two rows of three cells, for example. In any case the cells 3 and associated circuitry (described hereinafter) are enclosed in a unitary housing 5.

The battery housing 5 comprises a socket 4 having 4 connectors 4a, 4b, 4c, 4d. Socket 4a is connected to the positive terminal of the cells 3 via a fuse 14 and socket 4d is connected to the negative terminal of the cells 3. Socket 4b is connected to the negative terminal (effectively earth) via a thermistor 6 located in the close proximity of the cells 3 so that the signal appearing on terminal 4b is indicative of the local temperature of the battery.

Socket 4c is connected to the negative terminal of the cells 3 (effectively earth) via a resistor 7. The value of the resistor indicates the type of battery being used. For example, a resistor of 47,000 ohms may be used to identify a regular-energy battery having a capacity of 600 mAh, and a resistor of 68,000 ohms to identify a high-energy battery having a capacity of 850 mAh. This battery identification technique is the subject of our co-pending British patent application No. 9007681.1 (Our ref: PAT 90007) to which reference is invited for further details.

The battery 2 is capable of being connected to the telephone 1 as indicated by the arrow in Figure 1. Figure 2 shows the battery 2 connected to the telephone 1. The battery may be fitted by any suitable

mechanical means, for example a battery 2 may be arranged to fit slideably onto the telephone 1. The telephone comprises an electrical connector 8 comprising protruding conductive pins 8a, 8b, 8c, 8d which engage respectively in the complementary connectors 4a, 4b, 4c, 4d of socket 4 in the battery 2 when the battery is fully inserted on the telephone.

For the sake of clarity the positive and negative terminals 8a and 8d of connector 8 are shown without any further connections. Of course in practice these terminals would be connected to the main telephone circuitry for providing power thereto. It is noted here that the telephone 1 also includes a transceiver and all the other features conventionally found in a cellular telephone, but which also for the sake of clarity are not shown in the Figures. Also, since these aspects of the telephone are not relevant to the instant invention no further details will be given here, except to reiterate that the circuitry in the telephone is connected to the terminals 8a and 8d.

Terminal 8b connects with terminal 4b on the battery and, as mentioned above, the signal appearing thereon is indicative of the local temperature in the circuitry of the battery 2. This signal is applied to a microprocessor 9 within the telephone, which may use this temperature information to compensate for values of the battery voltage monitored during re-charging to give a more accurate indication of the charge state of the battery.

Terminal 8c of the telephone, which contacts connector 4c of the battery, is connected within the telephone 1 to a voltage source 10 generating a known voltage of, for example +5V via a resistor 11 having a known value of, for example, 180,000 ohms. Thus when the battery 2

is connected to the telephone the resistor 11 in the telephone is connected in series with the resistor 7 in the battery 2 in the manner of a potential divider. Indeed, the voltage at the junction 12 between the two resistors 10 and 7 indicates the value of the resistor 7 in the battery and hence is representative of the type of battery connected. For example with the values mentioned herein, when a regular-energy battery 2 is in use the voltage at junction 12 will be 1V nominal for an unused battery, and when a high energy battery is used the voltage at junction 12 will be 1.5V nominal for an unused battery.

A voltage sensor 13 is used to monitor the voltage at junction 12 and to feed a signal indicative thereof to microprocessor 9. The voltage detected by sensor 13 may deviate from the nominal value, particularly in the case of a previously used battery indicating that the capacity of the cells is below its maximum level. The value of the measured voltage may be transferred periodically in digitally encoded form to a semiconductor memory 6 within the battery housing 5. The memory 6, which may for example be an EEPROM is coupled via a data bus 15 and an address bus 19 to a connector 16 located externally on the housing 5. A complementary connector 17 is provided on the casing of the radio telephone so that the connectors 16 and 17 mate when the battery is connected to the telephone. The connector 17 is coupled to the microprocessor 9 in the telephone via a data bus 18 and an address bus 20. Whenever a charging programme is to be commenced the microprocessor is conditioned to interrogate the memory 6 in the battery 2 and to respond during recharging to ensure that the battery is recharged in accordance with a mode compatible with the prevailing condition of the battery. To this end the telephone may be adapted to be coupled to a charging unit capable of operating in

different charging modes in response to a control signal generated by the telephone, and managed by the microprocessor, as described and claimed in our co-pending British patent application No. 9007683.7 (Our Ref PAT 90005). Hence a charging programme can be selected which is best suited to the prevailing condition of the battery. This will have a beneficial effect on the longevity and performance of the battery.

In view of the foregoing description it will be evident to a person skillled in the art that various modifications may be made within the scope of the invention. For example, various battery parameters may be measured and then stored in the memory 6 within the battery housing, either instead of or in addition to the voltage characteristic. In particular, suitable parameters would be the actual operating voltage, the actual operating current, the actual charging voltage, the actual charging current, and/or the number of charging cycles which the battery has undergone. Also, it is noted that some or all of the parameter sensing means and the processing circuitry may be incorporated within the battery housing.

CLAIMS

1. A battery comprising a housing enclosing one or more rechargeable cells and memory means for storing information indicative of the condition of said cell(s).

2. A battery as claimed in claim 1, wherein said memory means is capable of storing at least two different categories of information relating to the condition of the cell(s).

3. A battery as claimed in claim 1 or claim 2, comprising means enabling information to be transferred to and/or from the memory means from outside the housing.

4. A battery as claimed in any of the preceding claims, including computer means coupled to said memory means for accessing the information stored therein.

5. A battery as claimed in claim 4, wherein the computer means is conditioned to determine the condition of said cell(s).

6. A battery as claimed in claim 4 or 5, wherein the computer is enclosed within the housing.

7. A battery substantially as herein described with reference to and illustrated in Figures 1 and 2 of the accompanying drawings.

8. Portable electronic apparatus adapted to have removably coupled thereto a battery in accordance with any of the preceding claims.

9. Portable electronic apparatus as claimed in claim 8, comprising computer means, and means for transferring information between said computer and the memory means when the battery is coupled to the apparatus.

10. Portable electronic apparatus as claimed in claim 8 or claim 9, said apparatus being in the form of a radio telephone.

11. A portable radio telephone in combination with a rechargeable battery coupled thereto substantially as herein described with reference to and illustrated in Figures 1 and 2 of the accompanying drawings.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number 9100057.0

Relevant Technical fields

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(ii) Int Cl (Edition 5) H01M; H02J

Search Examiner: M J Insley

Databases (see over)

(i) UK Patent Office

(ii) Online Databases used: Derwent WPI, CLAIMS

Date of Search: 9 April 1991

Documents considered relevant following a search in respect of claims

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
X	GB 2222494 A (POWAMATICS) see claims 1, 15	1, 2, 4-6 at least
X	GB 2219151 A (ULO-WERK) see claims 1-3	1, 2, 4-6, 8 at least
X	EP 0164890 (HEWLETT-PACKARD) whole document	1-6, 8, 9, at least
X	EP 0074444 (LEMELSON) see claims 1-4	1-6 at least
X	US 4737702 (NORLAND) see column 2 lines 18-40 column 4 lines 16-23 column 7 lines 33-36	
A	US 4743831 (TROXLER)	
A	US 4380726 (CANON)	
A	EP 0124739 (CEAG LIGHT)	

Category	Identity of document and relevant passages	Relevant to claim(s)

Categories of documents

X: Document indicating lack of novelty or of inventive step.

Y: Document indicating lack of inventive step if combined with one or more other documents of the same category.

A: Document indicating technological background and/or state of the art.

P: Document published on or after the declared priority date but before the filing date of the present application.

E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.

&: Member of the same patent family, corresponding document.

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).

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European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 04 29 0398

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X	WO 98/01917 A (MUNTERMANN AXEL) 15 January 1998 (1998-01-15) * abstract; claims 1,5,12; figures 1,2 * * claim 19 *	1,8-12, 16, 20-24, 29,30,33	TECHNICAL FIELDS SEARCHED (Int.Cl.7) G01R H01M
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	17 June 2004	Vytlacilová, L

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 04 29 0398

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17-06-2004

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